

NICE³ Technical Periodic Report #5

1. Title / State / Company

Precision Irrigation Technologies for the Agricultural Industry
Colorado Office of Energy Management and Conservation
Colorado Corn Administrative Committee

2. Periodic Activity Summary - In a narrative format, briefly describe the technical progress for the period.

The AccuPulse chemical application system was developed by Valmont Industries to apply a variety of liquid fertilizers and pesticides through an independent system mounted on a self-propelled sprinkler system. The unique applicator nozzles enable application rates much lower than conventional chemigation. The focus of this project is the development of software that integrates with the AccuPulse hardware, creating a complete system to apply chemicals with focused precision according to maps provided by the farmer or crop consultant.

Technical progress during this period focused on continuing field assessment and evaluation activities by Y-W Well Testing and Servitech in order to collect data for the development of computerized maps, which will be integrated with the software. USDA-ARS also continued testing work to fine-tune the AccuPulse hardware and collect data for the development of the software. Work is in progress to summarize the data into a short technical report and peer-reviewed paper that will be submitted for publication in 2002.

3. Milestone Table

a) Describe technical progress for the period, with ongoing activities and discuss the actions taken to meet the milestone deadlines.

Y-W Well Testing conducted well tests and soil samples. Y-W also completed the yearly soil compaction, water filtration, and fertilizer management study. Servitech has fine-tuned the management zones at the Yuma site. Once the fertility maps are completed, Servitech will compare them to the new management zones and make further adjustments if needed.

USDA-ARS is taking a combined approach using simulation software calibrated with measured chemical concentration data and measured application volumes. A finite element simulation software has been developed in VisualBASIC 6.0 to calculate the chemical concentration throughout a complete AccuPulse™ system over time. Validation and calibration of this program requires measured data from a complete 7 tower AccuPulse system mounted on a test stand in the lab. Work is in progress to program the control system and develop software for the test setup in the lab. We need to complete the setup in the lab in order to collect the necessary data for evaluating the uniformity of chemical applied and eventually variably apply chemicals through the AccuPulse systems that are installed at the demonstration host sites.

We were successful in obtaining good results from the image analysis software for percent coverage from the water sensitive cards but had marginal success in determining drop size distributions. Scanned and completed image analyses for the approximately 600 water sensitive spray cards were collected in 3 field tests this past summer.

Specific activities relative to each milestone are detailed below:

Milestone 16 - Y-W Well Testing has completed the well tests and the evaluations of the irrigation wells at the host demonstration sites. Y-W completed water management studies on a weekly basis and sent computer reports to the producers. Soil moisture blocks were installed in May and evaluated weekly into September. Additionally, soil samples were taken from all the sites down to 6 feet. Soil samples were done on September 27th. The soil compaction, water filtration, and fertilizer management study was done on November 5th.

Milestone 16 - Since the last report, the Yuma field was harvested and Servitech was able to compare yield maps to the aerial photos taken earlier in the season. With the use of both the yield maps and aerial photos, Servitech was able to more clearly define management zones. The field was then soil sampled on a 2.5 acre grid (a separate sample every 2.5 acres). The lab results are in, and the results are currently being mapped. At the Wiggins site, the onions have been harvested, and Servitech is waiting for yield data to be reported.

Milestone 16 - Electrical conductivity (EC) and selected soil cores were taken by USDA- ARS after harvest in the two study fields for characterizing and mapping soil texture and other soil water parameters. Lab analysis of soil cores is in progress. We obtained yield maps for about 90% of the corn field and about 33% of the onion field from the cooperating farmers. See attached maps.

Milestone 17 - A simulation program for predicting chemical applications has been completed and debugged. We are awaiting a complete dataset to properly calibrate the model.

Milestone 18 - The steel fabrication for the AccuPulse test framework in the lab has been completed. Work is underway to design and build a control system that uses individual tower operational data already collected in the field, to duplicate field operation times in the lab.

Milestone 18 - USDA-ARS worked with the farmers to apply fungicide with AccuPulse on half of the field. We then conducted side by side comparison of uniformity of coverage with aerial application in the same field.

Milestone 19 - The web site is ready for viewing within the team at the following address:

www.fostercommunication.com

Basic information is up on the web site; we are awaiting the technical reports, graphs, and input on other materials the team want to include.

Available names:

Precisionirrigation.org
Precisionirrigation.net
Precisionirrigation.info
renewableagriculture.com (and net and the rest)
energy.com (and net and the rest)

Precisionirrigation.com domain name is owned by the party below, but there is no web site attached:

Fay, Brian
Precision Irrigation
5662 Calle Real, #202
Goleta,, CA 93117

Milestone 20 - This quarter we have developed the materials for the Trade Show kiosk. Also included in the kiosk will be a looping PowerPoint presentation, brochures and technical reports.

Milestone 22 - The brochure has been edited by most of the team members.

b) Provide an explanation of technical difficulties encountered while testing, installing, or operating the system.

The sprinkler at the Wiggins host demonstration site would not run by itself for a well test by Y-W Well Testing.

Initially the several commercial software packages used by USDA-ARS required approximately 30 minutes to adequately analyze each water sensitive spray card. We were unable to scan the water sensitive cards at a scale necessary for drop-size analysis without introducing errors that greatly biased our drop size distribution.

USDA-ARS found little information in the technical literature for measuring and quantifying the percent coverage when using water-sensitive cards. Most technical guides (e.g. Extension bulletins, etc) explain how to make qualitative assessments through visual inspection, but do not address the need for a quantitative methodology without human bias of the evaluator.

c) Explain the steps taken to resolve these difficulties.

Y-W Well Testing contacted the producer at the Wiggins host demonstration site, and he fixed the sprinkler before the next well test.

Because of the limitations presented by the commercial software packages, USDA-ARS developed an image analysis program to automate the water sensitivity analysis process, reducing the analysis time by a factor of 10, making it possible to analyze the field data in a timely and affordable manner. We have not yet found any other affordable software that will help us to obtain drop-size distributions.

USDA-ARS quantified uniformity of coverage by following a procedure analogous to the coefficient of uniformity used for sprinkler irrigation. Instead of using water depth at each point

in the grid pattern, we used the percent coverage value obtained from the water-sensitive paper image analysis. This enabled us to express percent coverage over a much larger area as well as across spray applicator overlaps.

d) Describe any known or potential changes in milestone dates.

Milestone 10: Initiation of the video production will be delayed until January 2003 when significant project results and product information can be included.

Because USDA-ARS is moving to new shop facilities in June 2002, we have decided to postpone setting up the AccuPulse test stand until we have moved into the new facilities. Consequently we won't have any lab data until fall 2002 to calibrate the simulation model. This does not impact any planned milestone dates; the software documentation and development will still be completed in 2003.

e) Address activities and planned accomplishments for the upcoming quarter.

Y-W Well Testing will finish and apply data that was collected over the past year, and compute the soil fertilizer program study and soil compaction study.

Servitech will work on developing management zones for both host demonstration sites and will soil sample the Wiggins field on a 2.5 acre grid if the weather allows.

USDA-ARS is beginning to plan a chemical efficacy field scale study for 2002, comparing AccuPulse with conventional spray technology.

Colorado Corn and Foster Communications will gather the team to finalize the promotional materials. Once the team provides additional input on content and accuracy of information, the brochure will go to print. The team will also determine the feasibility of a CD-ROM version of the brochure to allow for interactivity and instant updating as the project matures.

Colorado Corn/Foster Communications will obtain technical information from team members for inclusion on the web site.

Colorado Corn will investigate the possibility of requesting Valmont to supply a "giveaway" for trade show presentations. The product would display the project web site and include a phone number people can call for more information.

4. Discuss results (testing etc.) and their implications to the project. Discuss any necessary or anticipated milestone additions or deletions.

The field assessment and evaluation activities and the testing work on the AccuPulse System that has been conducted to date is building a collection of data that will be used to integrate the AccuPulse hardware with computerized maps provided by the farmer or crop consultant. This integration will occur throughout the next year, testing of the integrated system will be completed in 2002, with full deployment of the integrated system to occur in 2003.

5. Attach publications written that relate to the project (internally or externally produced). List any planned publications or conferences to be attended related to the project for the next quarter.

Y-W Well Testing is sending one technician to a workshop/class on water well testing to be certified by the state of Colorado. The other technicians get re-certified with the state by doing well tests. Y-W Well went to the Greeley Farm Show, Corn Grower banquet, Greeley Youth Water Fest, Northeast Colorado Youth Water Fest, and Precision Farming meeting. At the Precision Farming meeting, Y-W gave a presentation on the soil moisture blocks. Members of Y-W Well Testing are also on the Northeast Water Quality Committee and the Ogallala Aquifer Symposium Committee.

USDA-ARS presented a paper (see attached) at a technical session of the Irrigation Association Expo in San Antonio, TX in November 2001. USDA-ARS also plans to submit a peer-reviewed paper on the performance of AccuPulse to Applied Engineering in the first part of 2002.

6. Discuss any key personnel changes (including state, cost-share, subgrantee, and others involved).

Vern Bauer has joined Y-W Well Testing; he was formerly with the SE Pump Association in Burlington. Vern has been testing irrigation wells for 16 years and will be located in the Burlington area. Conrad Bauer has rejoined Y-W Well Testing, and Dave Keeler remains as the manager.

An engineering student involved in this project through USDA-ARS will begin his MS degree program in January 2002. Although he has already been involved on several aspects of the project, he is planning to focus his thesis work on the development of software that integrates with the AccuPulse hardware to apply chemicals according to maps provided by the farmer or crop consultant. A computer programmer began working for ARS and will be available for some consulting on an as-needed basis.

7. Discuss any cost-sharing partner/demonstration partner changes.

Potatoes will be grown by a different farmer in 2002 at the Wiggins host demonstration site. We are not sure how much field data collection will be possible because of his concerns about spreading diseases. At the present time we do not know his attitude about cooperating with us and we recognize his legitimate concerns about spreading diseases with foot traffic in the field. We will be meeting with the new farmer within a couple of weeks to explore our options for fieldwork in 2002.

8. Discuss any other topics that are relevant to the scope and progress of the project.

Y-W Well Testing received a grant from Con Agra Foundation to update their computer and printer.